Diseases of Carbohydrate Metabolism

Disease		Cause (Deficiency of)	Symptoms and manifestations	Treatment
Lactose intolerance (Inherited lactase deficiency)		The gases produced from fermentation of unabsorbed sugars by intestinal bacteria.	Starts with early lactation. The infant complains of abdominal distention and colic.	Lactose free milk. Then after beginning of eating, lactose free diet.
Inherited sucrase deficiency		The gases produced from fermentation of unabsorbed sugars by intestinal bacteria.	Starts later with addition of cane sugar to the diet. The infant complains of abdominal distention and colic.	Lactose free milk. Then after beginning of eating, sucrose free diet.
Lactic acidosis		Pyruvate dehydrogenase (PDH)	Accumulation of pyruvate that is converted to lactate ➔ lactic acidosis.	
Hemolytic anemia		Deficiency of glycolytic enzyme: - 95%: Pyruvate kinase. - 4%: Phospho-hexose isomerase. N.B. RBCs dependent on glycolysis only for production of energy.		
Favism		Glucose 6-phosphate dehydrogenase (G6PD).	Decreased concentration of NADPH ➔ decreased capacity of RBC's to protect itself from oxidative damage.	- Avoid: fava beans and certain drugs that produce H_2O_2, like: premaquine, aspirin, and sulfonamides. - Blood transfusion during the attack of hemolysis.
Essential pentosuria		Genetic deficiency of L-xylulose reductase	Accumulation of L-xylulose and its excretion in urine.	
Glycogen storage diseases (Glycogenosis)	**Type I: Von Gierke's**	Genetic deficiency of Glucose 6 phosphatase (G6Pase)	- Accumulation of G6P & glycogen in liver & kidneys ➔ fasting hypoglycemia, hyper-lipidemia, ketosis, hyperuricemia or Gout.	
	Type V: McArdle's Syndrome	Genetic deficiency of Muscle phosphorylase	- Accumulation of glycogen in muscles ➔ painful cramps. - Accumulation of glycogen & decreased ATP ➔ increase serum levels of muscle enzymes (creatine phosphate, lactate dehydrogenase).	
Fructose 1,6 Bisphosphatase (F1,6BP) Deficiency		Fructose 1,6 Bisphosphatase (F1,6BPase)	- Accumulation of F1,6 BP. - Depletion of liver phosphate & inhibition of glycogen phosphorylase. - Inhibition of glycogenolysis & impaired gluconeogenesis. ➔ Fasting hypoglycemia (in infants).	
Hereditary defects in fructose metabolism	**Essential fructosuria**	Fructokinase enzyme	Fructosemia & fructosuria after ingestion of fructose or sucrose.	
	Hereditary fructose intolerance	Aldolase B (liver enzyme)	Accumulation of Fructose 1 phosphate (F1P) + depletion of liver phosphate ➔ inhibition of glycogen phosphorylase ➔ hypoglycemia after fructose or sucrose feeding.	
Galactosemia		Galactokinase. Uridyl transferase (most common). 4 epimerase.	- In eyes: blood galactose reduced by aldose reductase to form galactitol (dulcitol) & its accumulation lead to cataract. - Accumulation of galactose 1 phosphate & depletion of liver phosphate ➔ inhibition of glycogen phosphorylase ➔ hypoglycemia after galactose or lactose feeding. - Later on: Liver failure, mental deterioration & neuronal dysfunction.	- Galactose free diet. - Children can form UDP-Gal from UDP-Glc by the epimerase, which explain their normal growth. - Later on: children can utilize galactose normally duo to development of UDP-Gal phosphorylase which can replace the Gal-1-P Uridyl-transferase.
Muco-poly-saccharidosis		Genetic deficiency of one of the lysosomal enzymes that degrade GAGs	Accumulation of GAGs in tissues ➔ Cloudy corneas, mental retardation, stiff joints & hepato-spleeno-megaly.	This disease is usually progressive and leads to death in early childhood.

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Disease	Definition	Symptoms & manifestations	Types		Causes
Hypoglycemia	It is drop of blood glucose level below the normal fasting levels (>45mg/dl).	- Rapid pulse. - Sweating. - Headache. - Drowsiness. - Tremors. - If not treated the condition may lead to coma and even death duo to affection of brain tissue.	Fasting hypoglycemia	Hyper-insulism	Hyperactivity, hyperplasia or tumors of pancreatic B-cells (insulinoma). Over dosage of insulin, even in diabetic patients, may produce hypoglycemia.
				Hypo-secretion of anti-insulin hormones	Hypo-function of pituitary, adrenals and thyroid glands. In all these conditions, insulin acts unopposed and causes lowering of blood glucose.
				Liver diseases	Decreased glycogen storage and impaired gluconeogenesis.
				Chronic renal disease	Impaired gluconeogenesis.
				Hereditary metabolic disorders	- Von Gierke's: duo to deficiency of G6Pase. - F1, 6 BPase deficiency. - Genetic defects that produce impairment of fatty acid oxidation. It is explained that FA oxidation spares glucose oxidation and stimulate gluconeogenesis during fasting.
			Postprandial hypoglycemia	Alimentary post-prandial hypoglycemia	Gastrectomy ➔ Rapid absorption of glucose ➔ Rapid rise in blood levels ➔ excessive secretion of insulin ➔ hypoglycemia.
				Reactive hypoglycemia	Normally: Rise in blood glucose levels ➔ Secretion of insulin ➔ Temporary (short time) hypoglycemia to fasting level or lower. This is known as <u>Reactive Hypoglycemia</u>. If prolonged it indicates either exaggerated insulin response or decreased activity of anti-insulin hormones.
				Hereditary metabolic disorder	- Hereditary fructose intolerance: deficiency of aldolase B. - Galactosemia: deficiency of Gal-1-P Uridyl-transferase.
Glucosuria	It is the presence of glucose on urine in amounts more than 30 mg/dl which are detectable by ordinary test methods: Fehling's, Benedict's & Urinary strips.	The presence of glucose on urine in amounts more than 30 mg/dl	<u>Hyperglycemic glucosuria</u> Occurs when blood glucose level exceeds the renal threshold (180 mg/dl)	Diabetes mellitus	Diabetes mellitus.
				Epinephrine glucosuria	As in emotional, stress glucosuria or pheochromocytoma (epinephrine secreting tumor).
				Alimentary glucosuria	Increase glucose absorption duo to Gastrectomy.
			<u>Normoglycemic or renal glucosuria</u> In these cases the blood glucose level is within the normal range	Congenital glucosuria (benign glucosuria or diabetes innocens)	Congenital defects on renal tubular mechanism for reabsorption of glucose.
				Acquired renal diseases	As in case of nephritis.
				Pregnancy glucosuria	It appears during pregnancy and disappears after labor. N.B. Phlorhizin produces this type of glucosuria duo to inhibition of the sodium dependent transporter of renal tubules.

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